The Discovery of Hydrothermal Vents

25th Anniversary CD-ROM

Some Like it Hot

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The seafloor was long thought to be inhospitable to life, a muddy, rocky desert of enormous pressures, near-freezing temperatures, eternal darkness, and limited food supply, where few creatures could survive.

But in 1977, in a vent field on the Galápagos Rift, scientists in *Alvin* observed and sampled strange sea creatures reeking of hydrogen sulfide. The discovery turned the field of marine biology on its ear.

The vents were deep sea oases, crammed with three-meter tube worms, giant clams, mussels, strange fish, and bizarre crabs that formed the densest communities of living organisms in all the oceans. Far beyond the reach of the sun and the realm of photosynthesis, this world was built on chemosynthesis, where inorganic chemicals like sulfur, methane, ammonia, and iron formed the staff of life.

Oceanographers have discovered hundreds of species at the vents, and the fauna varies widely between Atlantic and Pacific Ocean vents. Common to all the vents, however, are the bacteria at the bottom of the vent food chain. These micro-organisms live off geothermal energy supplied by the earth's molten core—they consume the hydrogen sulfide and other energy-rich chemicals in the hot vent fluid. Many bacteria grow in both "warm" and "hot" vent environments, the latter at temperatures where the pressure of overlying water keeps the fluid from boiling.

One group of vent micro-organisms, called hyperthermophiles, populate "hot" vent sites and thrive in an environment that would be toxic to most of the rest of the globe's creatures. These primitive bacteria are closely related to the first life forms that arose in the primeval oceans, and traces of their not-so-distant ancestors have been found in ore deposits hundreds of millions of years old. In fact, some scientists think they may prove that life can exist in harsh environments elsewhere in the universe.

The more complex animals live off the chemosynthetic vent bacteria that grow at "warm" temperatures, either eating them directly or harboring them in their bodies and living off the organic compounds the bacteria produce.

At TAG, the most striking creature is the gray shrimp that throngs the vent area in dense hordes like swarming bees. The shrimp were originally thought to be blind and one species was named *Rimicaris exoculata*, Latin for "eyeless rift shrimp." Further research showed that the shrimp have a reflective organ on their backs that contains rhodopsin, a light-sensitive material common to the eyes of many creatures. This organ, scientists proposed, meant there had to be a light source at the vents. Special cameras sent down on *Alvin* revealed that the vents glowed, but at a wavelength humans cannot see. Proposed light sources include crystallizing chemicals, the sound of collapsing bubbles, cracking rocks, and the decay of radioactive elements.

As many as 1,500 of these shrimp have been counted in a little over a single square meter, and when *Alvin*'s probes brush them from the rocks they rush back in a single-minded frenzy.

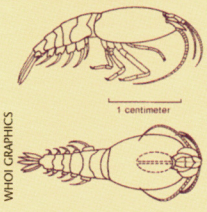
According to WHOI researcher Carl Wirsen, the shrimp feed on two bacteria sources. They graze on a layer of sulfide-utilizing bacteria that covers the mound's metal-sulfide rock surfaces. They also jostle to bathe in the sulfide-rich fluids that flow past the surface of the rocks. These fluids in turn feed colonies of unique bacteria that grow on the shrimp. "The shrimp can harvest the attached bacteria at will, and, naturally, as the shrimp climb over each other, these bacteria break off and the shrimp will consume them," says Wirsen. "Basically these shrimp are carrying an important food source on their own bodies. It's almost like the shrimp are ranching these microorganisms."

STEPHEN MOLYNEAUX

Biologist Carl Wirsen and shrimp collected from the TAG mound.

CARL WIRSEN

Left: A cross section of the leg of the shrimp *Rimicaris exoculata*, showing the filamentous bacteria that attach themselves to the shrimp's mouth parts, bodies and legs. The shrimp's leg is in the lower left corner; the bacteria extend into the water on the right. Right: Shrimp cluster around a vent orifice.



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